# River Dynamics and Erosion

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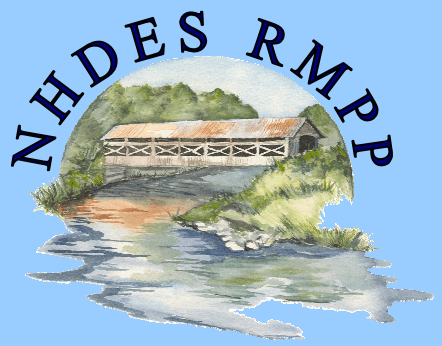
NHDES Rivers Coordinator



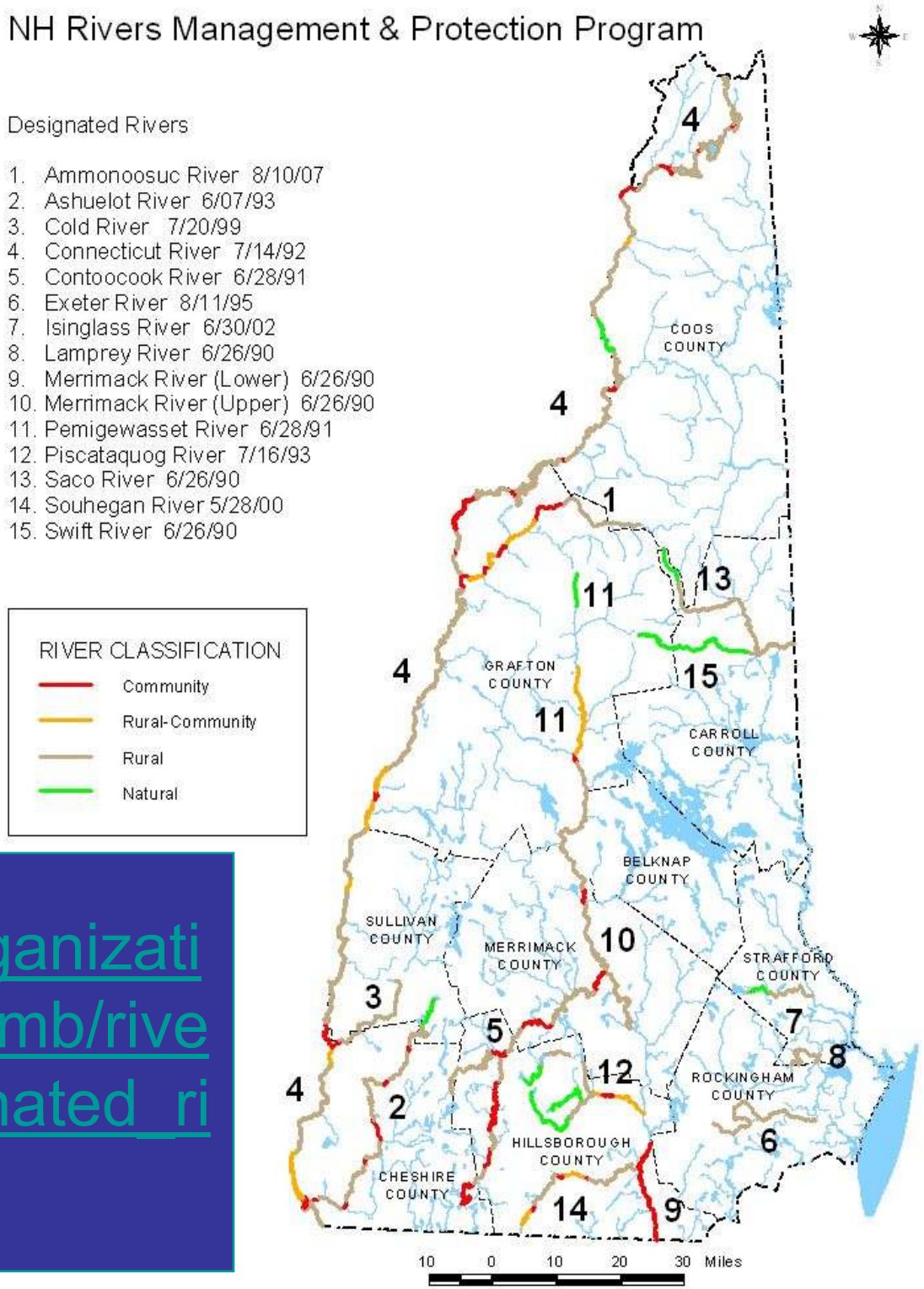

Presented to:
Great Bay Siltation Commission
December 1, 2008

# DESIGNATED RIVERS

NH Rivers Management & Protection Program

Designated Rivers

1. Ammonoosuc River 8/10/07
2. Ashuelot River 6/07/93
3. Cold River 7/20/99
4. Connecticut River 7/14/92
5. Contoocook River 6/28/91
6. Exeter River 8/11/95
7. Isinglass River 6/30/02
8. Lamprey River 6/26/90
9. Merrimack River (Lower) 6/26/90
10. Merrimack River (Upper) 6/26/90
11. Pemigewasset River 6/28/91
12. Piscataquog River 7/16/93
13. Saco River 6/26/90
14. Souhegan River 5/28/00
15. Swift River 6/26/90

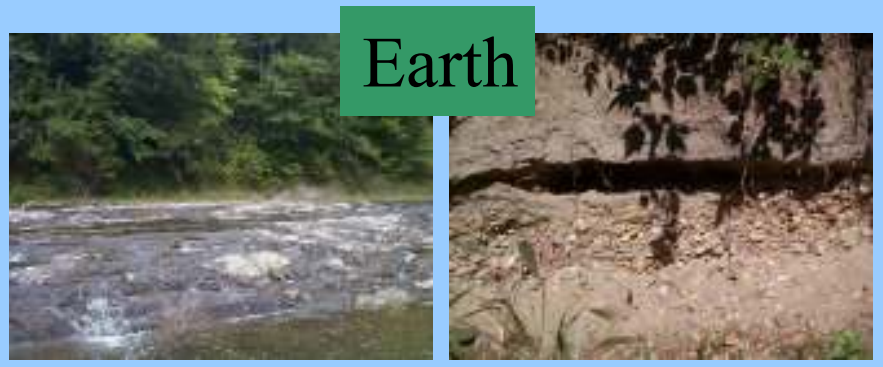



http://des.nh.gov/organization/divisions/water/wmb/rivers/documents/designated_rivers.pdf

# Fluvial Geomorphology

Fluvial =


Geo =




Morphology =

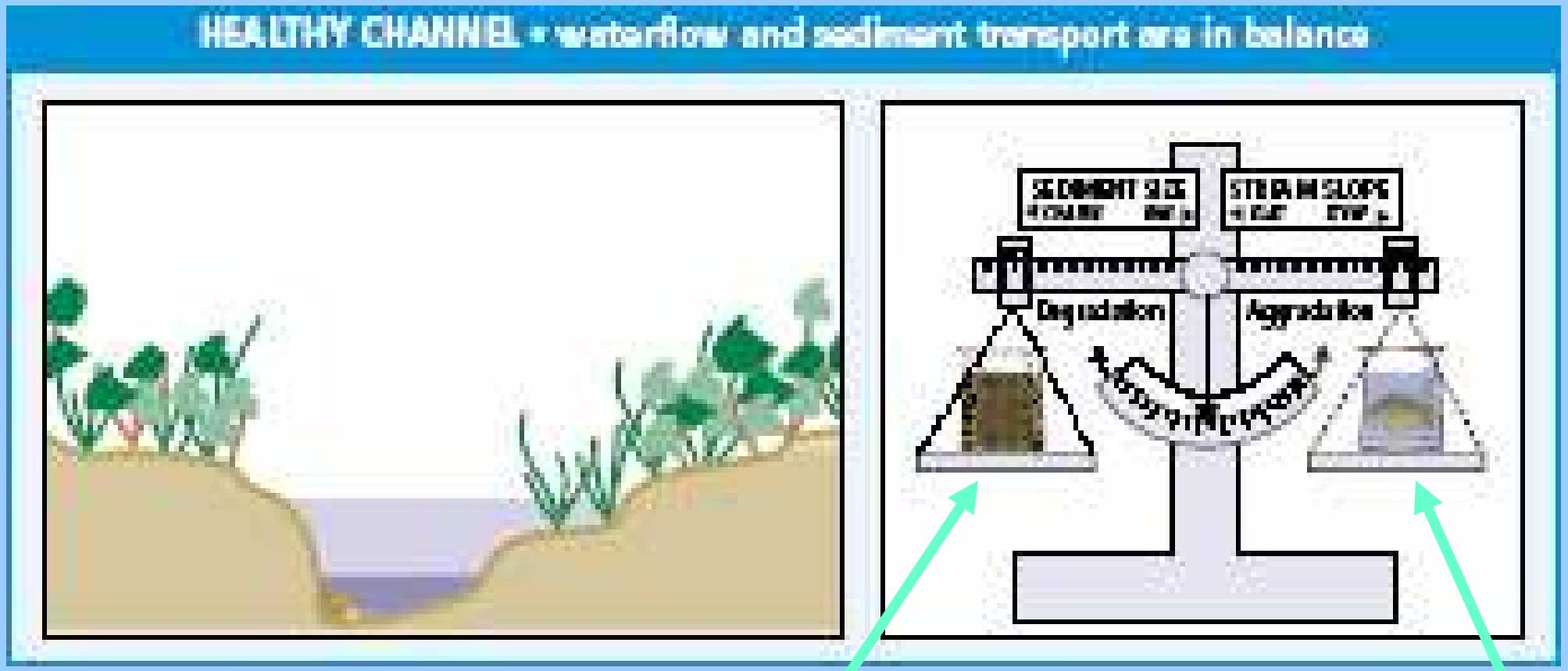

Fluvial Geomorphology = The Interaction of Water and the Landscape through which it Works

# Streams Are Dynamic

- Streams are dynamic systems that balance water flow and sediment transport

- A river's energy must be in balance with the size and volume of sediment carried by the river.

# Striving for Balance

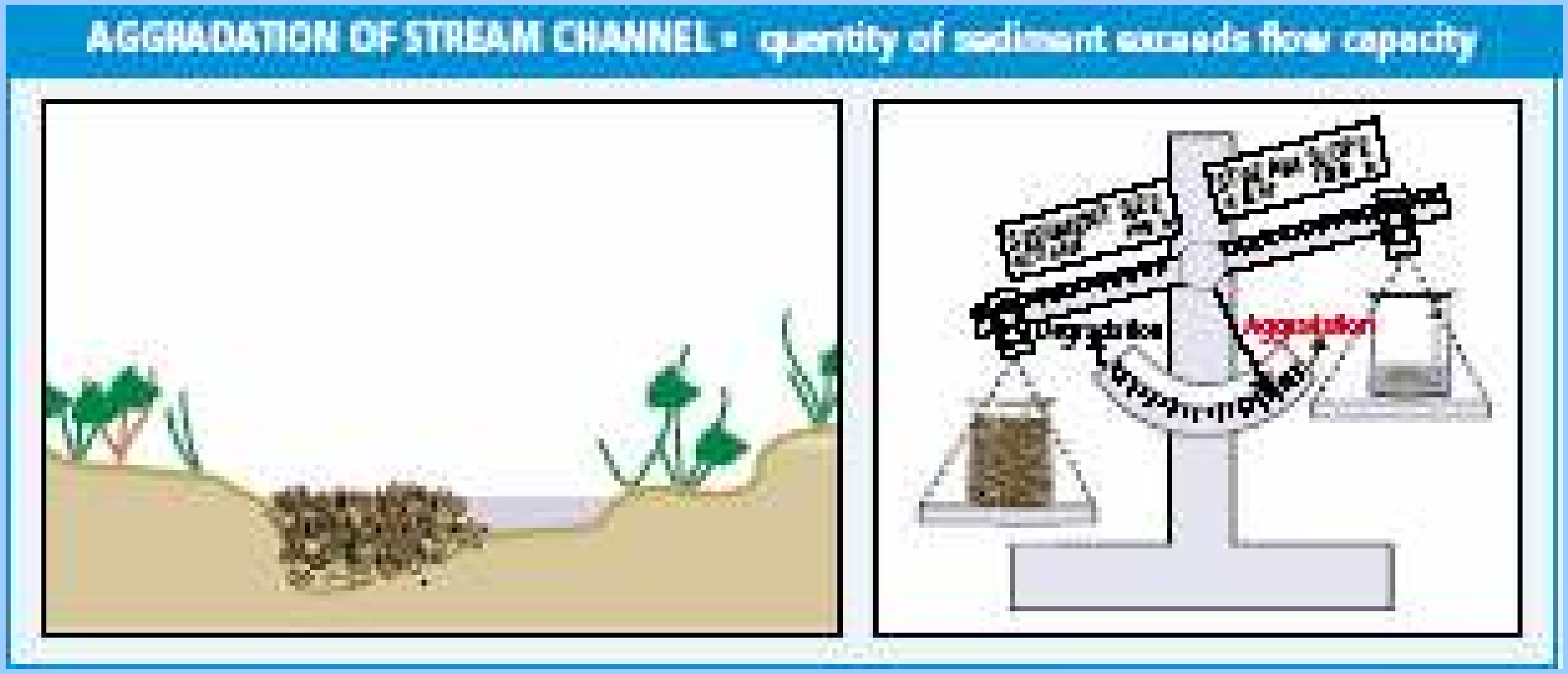



Sediment Load

Transport Capacity

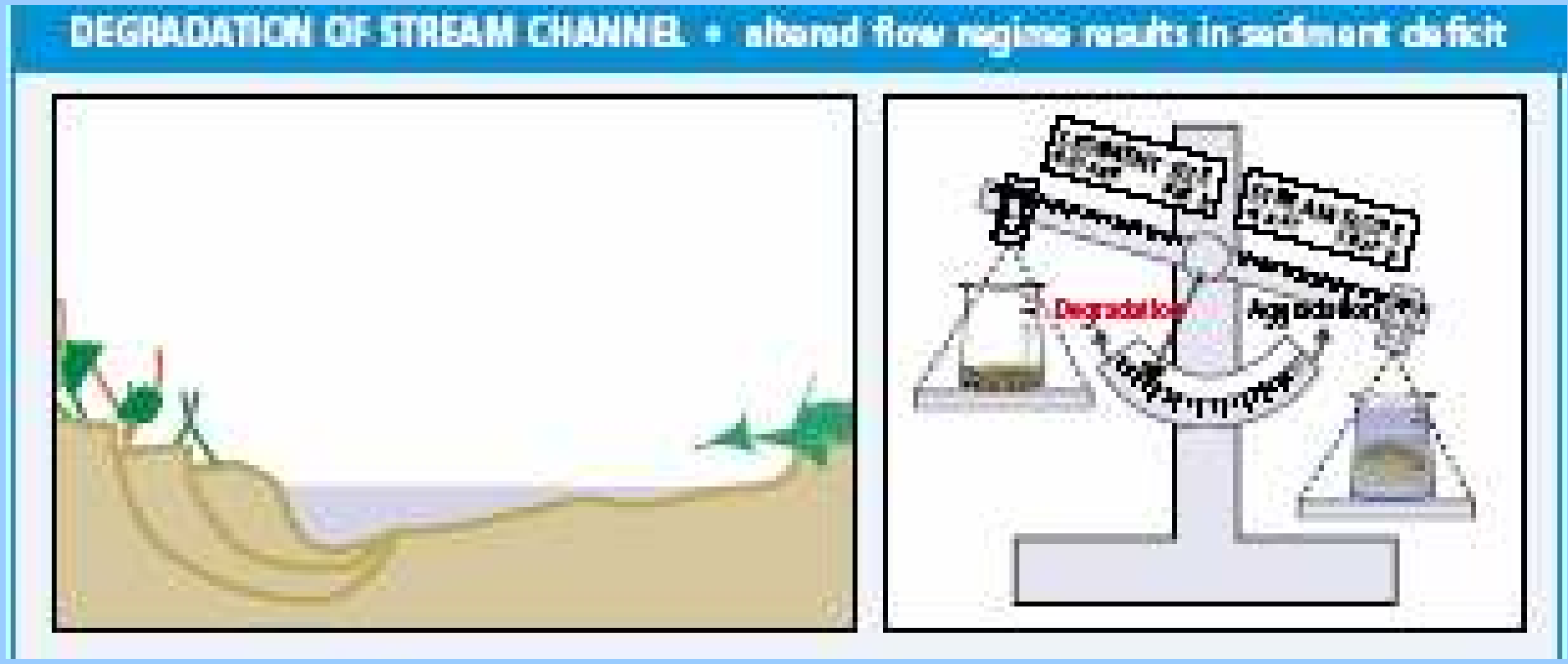
Source: Ontario Ministry of Natural Resources, 2001

# Striving for Balance




Source: Ontario Ministry of Natural Resources, 2001

# Striving for Balance



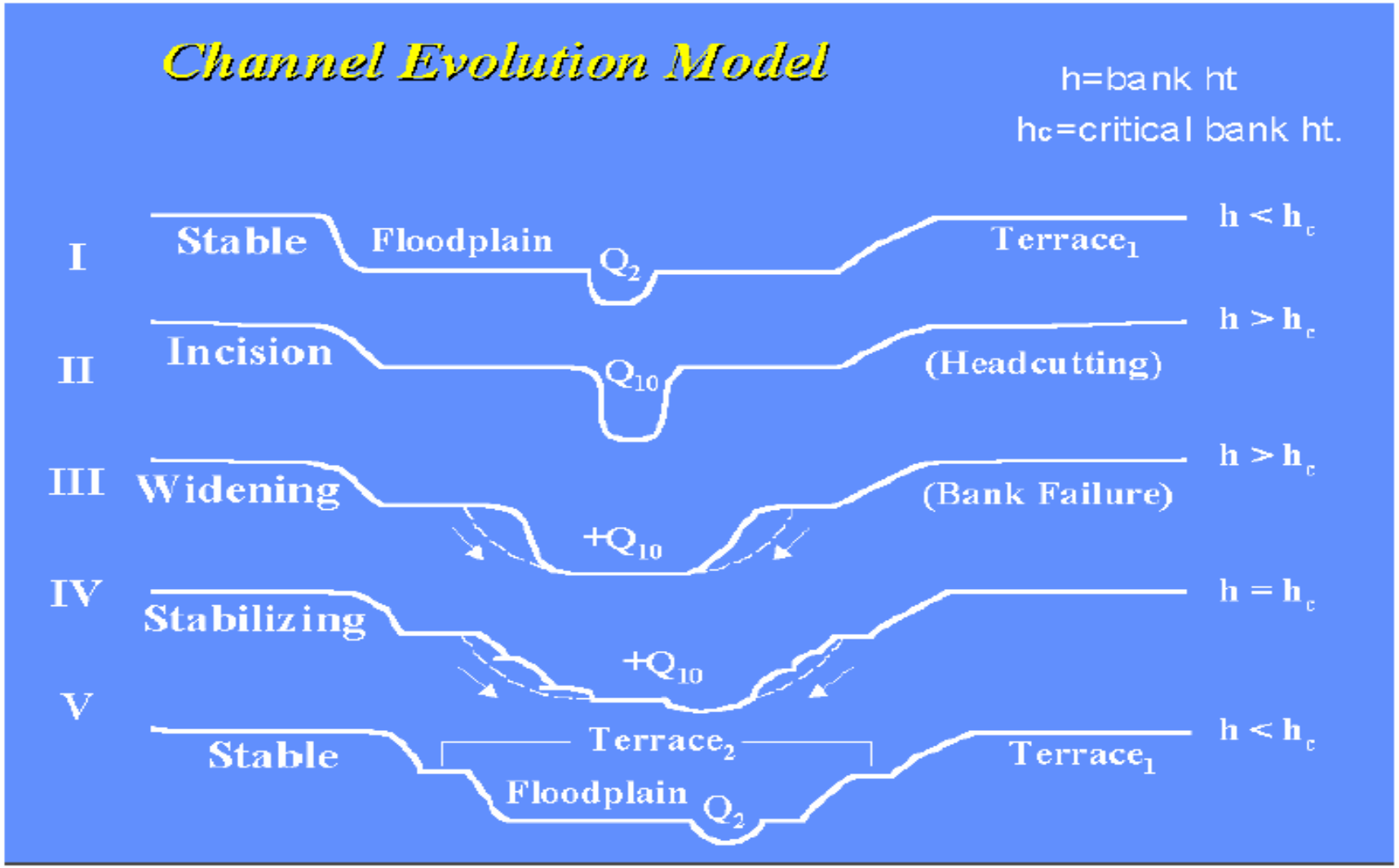

Source: Ontario Ministry of Natural Resources, 2001

# Striving for Balance

- When river channels are altered by humans or nature, the river must readjust to reach its former balance.
- Adjustments to Dimension, Profile and Pattern

# Striving for Balance

Figure 3: Channel Evolution Model




From Schumm, Harvey, and Watson, 1984.

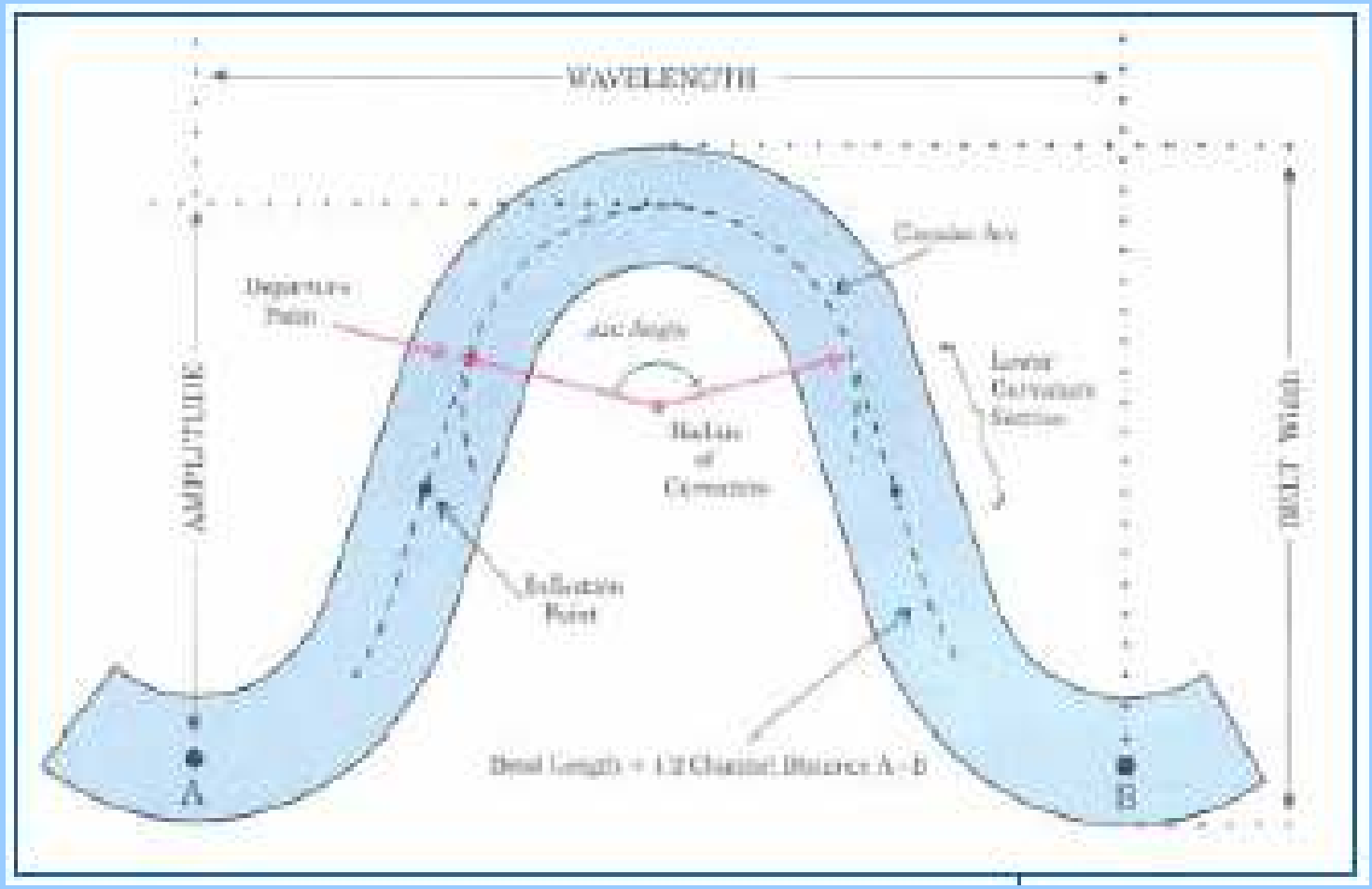
# Warren Brook – NHDES Biomonitoring Station, Alstead

October 21, 2004

October 17, 2005

# Striving for Balance

## Channel pattern




Source: Rosgen, 1996

# Understanding Erosion

- Erosion is an ongoing natural process
- The rate of erosion is affected by soil type, slope, precipitation, and velocity
- Erosion can be slowed but not stopped

# When is Erosion a  Problem?

- People forget that rivers are systems in dynamic equilibrium
- Structures are built too too close to eroding banks
- Riparian buffers aren’t maintained
- Other natural or human activities accelerate the natural rate of erosion

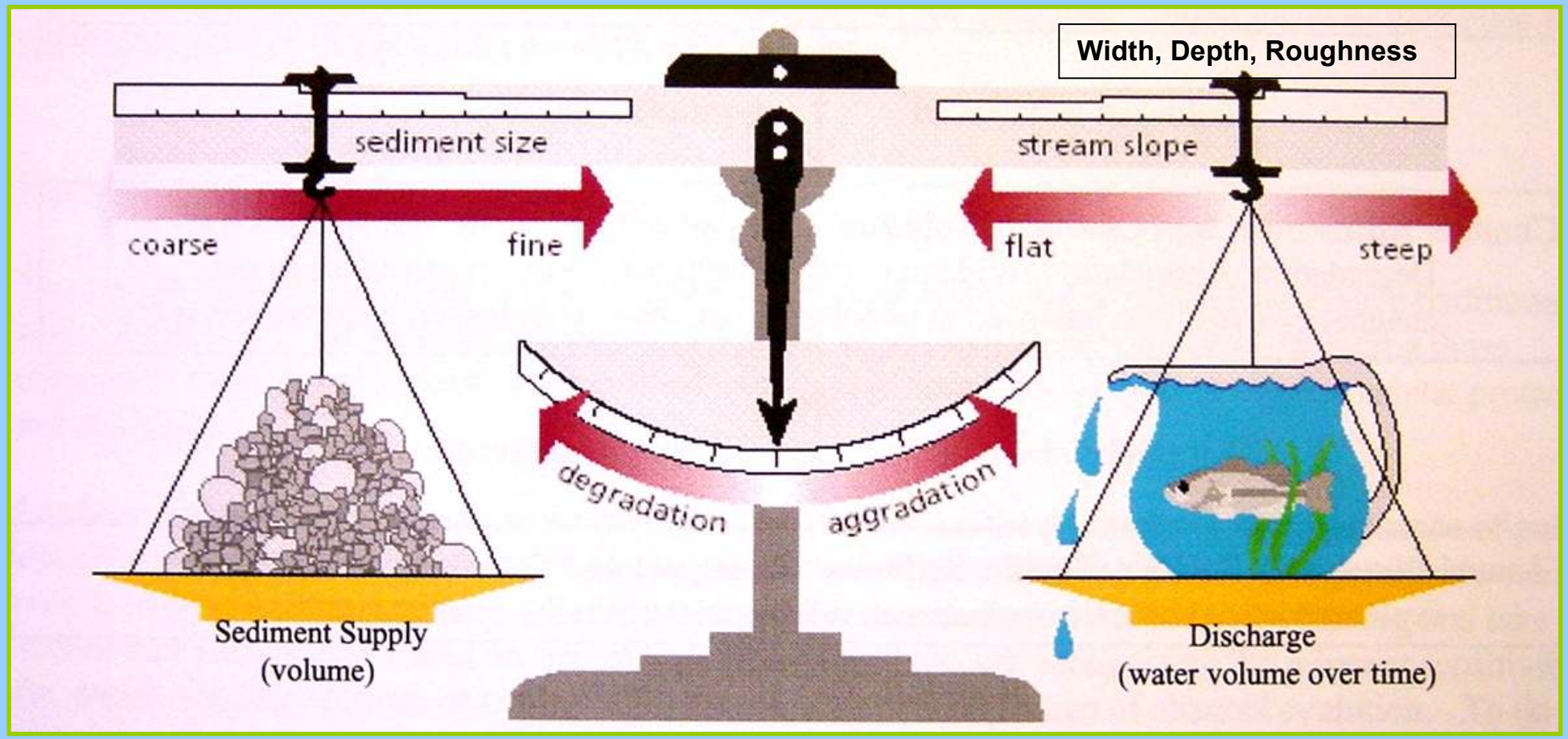
# Functions/Values of Healthy Streams

- Flood mitigation
- Water supply
- Water quality
- Sediment storage and transport
- Habitat
- Recreation
- Transportation
- Aesthetic qualities

# Channel Equilibrium

Sediment Load

Transport Capacity




Lane (1955)

# And...many streams are rapidly changing due to:

- Greater land development in susceptible areas

- Channels are enlarging due to stormwater conveyance

- Potential global climate shifts or cycles

- Traditional river management don't support natural hydrology

# Results..

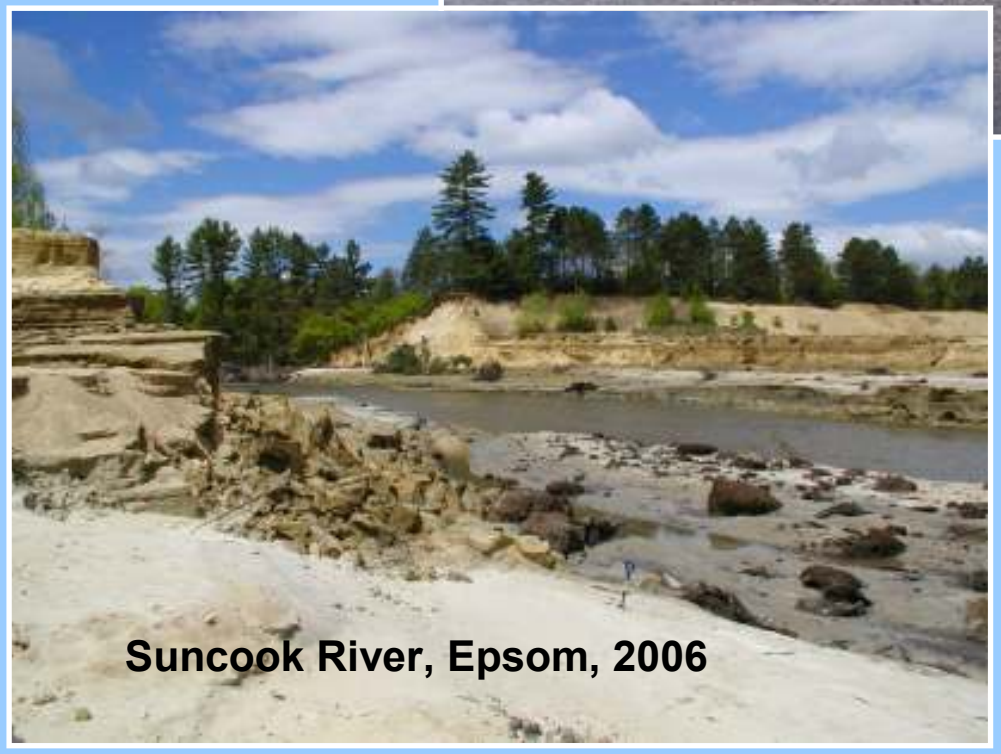
High flows result in high erosive power kept in the channel,

instead of allowing the energy of the water to flow onto floodplain

Source: Vermont ANR, River Management Program, 2008

# Channel adjustments during high water events can have devastating economic consequences

## NH Flooding: May 2006, April 2007 $75.6 Million In Damages


# Riverine Erosion Hazards - a National Concern

- 1/3 of the Nation's Streams Experience Severe Erosion (National Research Council, 1999)
- Catastrophic Erosion Costs $595 Million/year (2008 dollars)




# Cycle of Escalating Costs, Risks, and Ecosystem Degradation

Floods and Property Damage


Dredge, Berm and Armor

Encroachment

ermont ANR, River Management Program, 2008

# How Can We Mitigate These Impacts?


Honey Brook, Barre, VT 2007

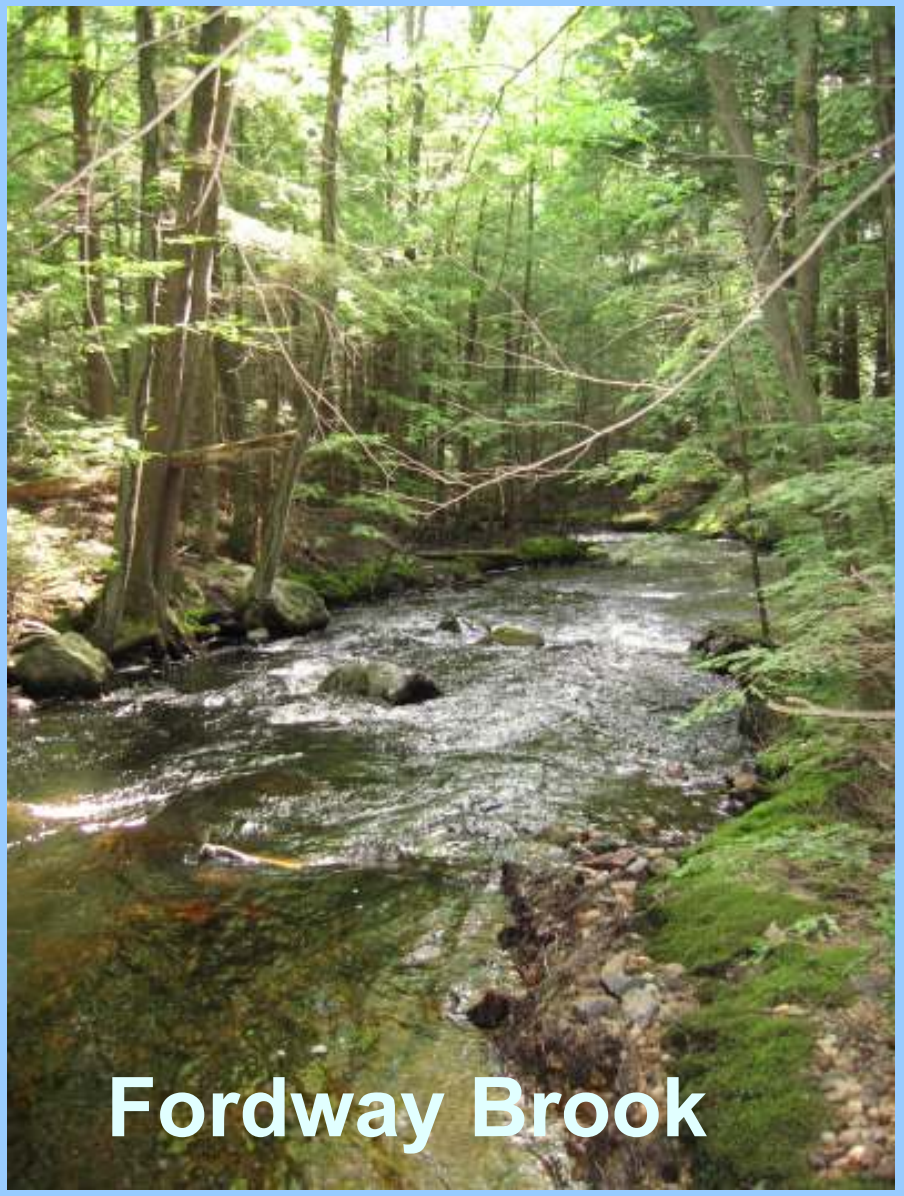

Suncook River, Epsom 2006


Warren Brook, Alstead 2005


Sucker Brook, Williston, VT 2005

# Exeter River Geomorphic Assessment:

## Restoring and Maintaining Healthy River Conditions



# Geomorphic Assessment

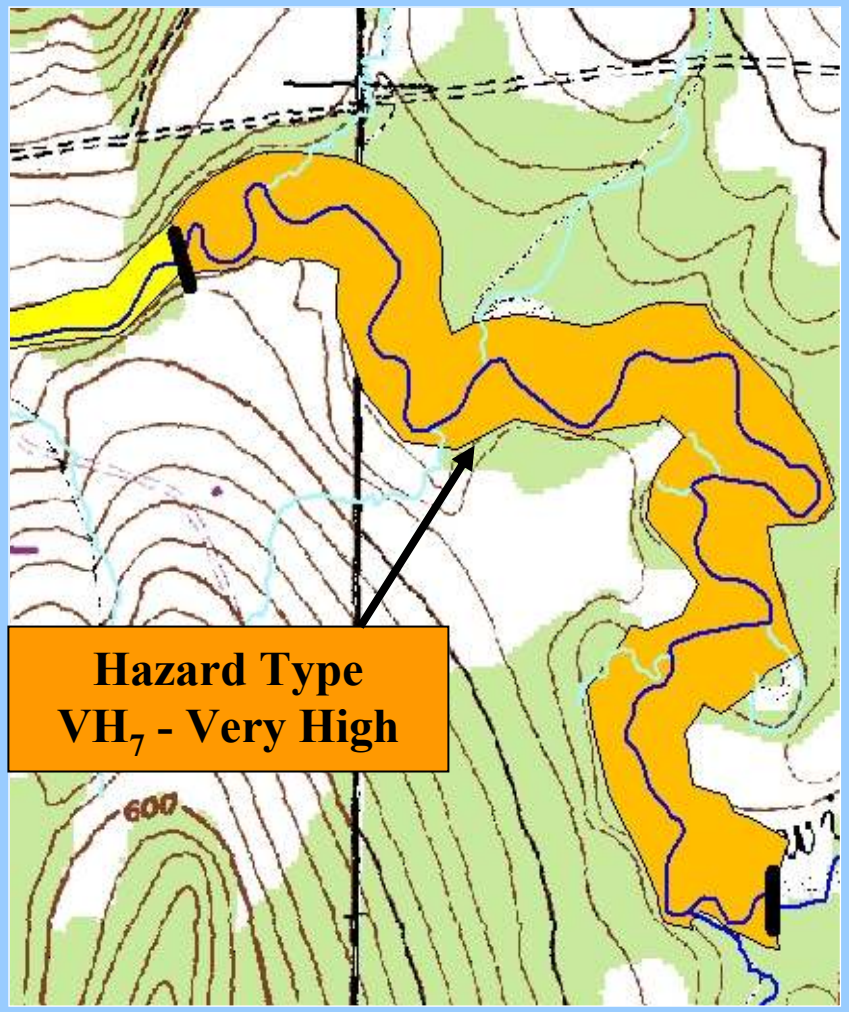
**Inherent Sensitivity** + **Adjustment Processes**

- Transport Capacity
- Bed and Bank Materials
- Sediment Supply

- Reference Condition
- Major Adjustment
- Stream Type Departure

Source: Vermont ANR, River Management Program, 2008

# Fluvial Erosion Hazard Planning

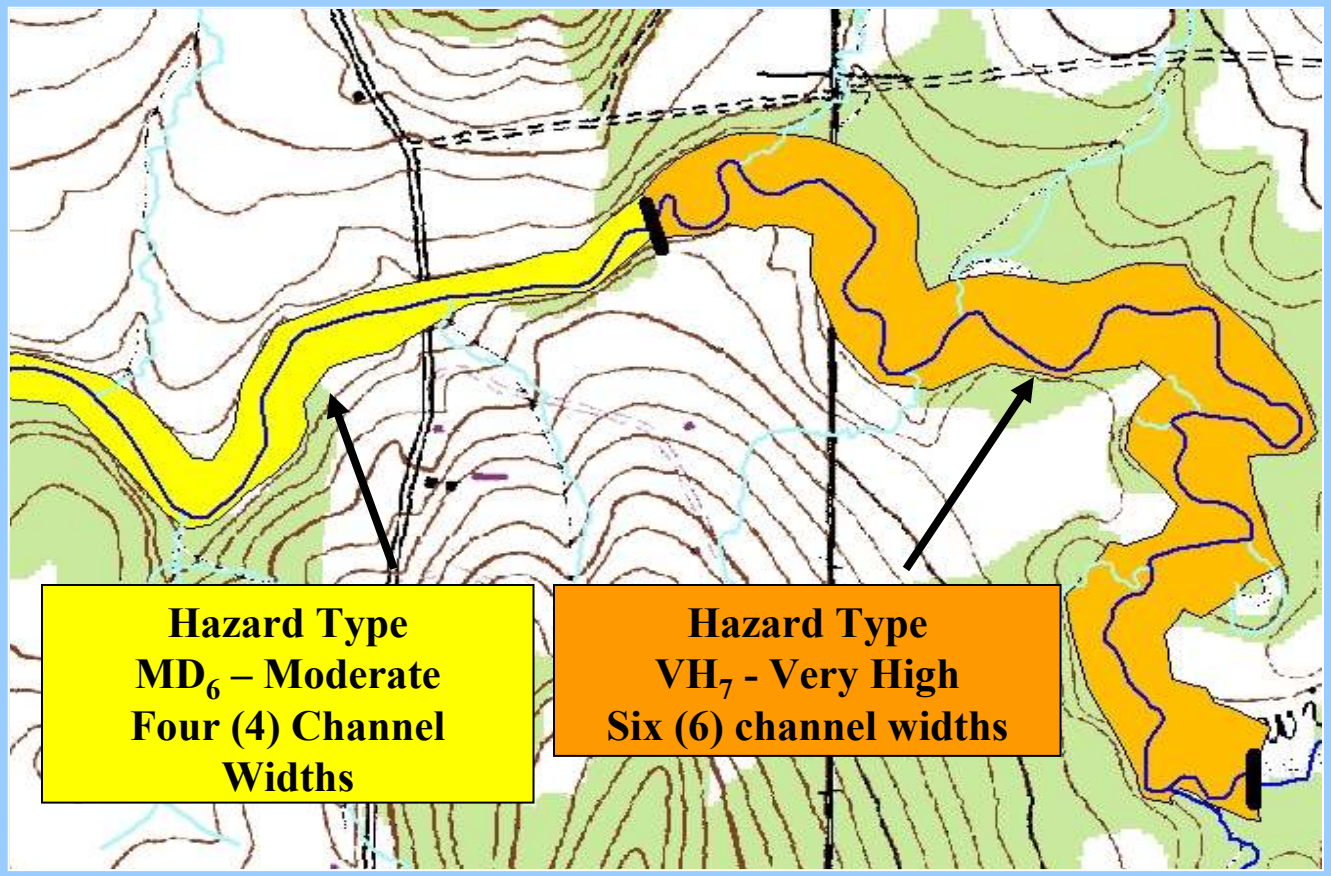



**Based on identification of degree & likelihood of fluvial adjustments; assigns a corresponding level of risk to infrastructure & property within the river corridor**

Source: Vermont ANR, River Management Program, 2008

# FEH Corridors based on Erosion Hazard Ratings and Belt width

| FEH Rating | Belt Widths |
|---|---|
| Very Low (VL) | Reference channel width |
| Low (LW) | Reference channel width |
| Moderate (MD) | Four (4) channel widths |
| High (HI) | Six (6) channel widths |
| Very High (VH) | Six (6) channel widths |
| Extreme (EX) | Six (6) channel widths |




Source: Vermont ANR, River Management Program, 2008

# Breaking the Cycle
# Through FEH-based Corridor Protection

- **Avoids** Land Use Constraints Which Prevent Maintenance or Achievement of the Equilibrium Condition
- Provides Low Cost Solution
- Enhances Public Safety
- Minimizes Economic Losses
- Manages towards Sustainable Healthy Stream Conditions

Source: Toronto Region Conservation Authority, Humber River Watershed Flood Management Program, 2008

# NH Support for FEH:

- **NH Hazard Mitigation Plan (DOS,2007)**
  **http://www.nh.gov/safety/divisions/bem/HazardMitigation/haz_mit_plan.html**

- ***Independent Evaluation of Recent Flooding in New Hampshire.* FEMA July 2008.**
  **http://des.nh.gov/organization/divisions/water/dam/documents/flood_report_nh_flooding_analysis.pdf**

- **Comprehensive Flood Management Study Commission, New Hampshire House Bill 648 (Chapter 179 Laws of 2007), Final Report, September 2008.**
  **http://gencourt.state.nh.us/statstudcomm/reports/1853.pdf**

- **LSR 2009-H-0207-R authorizing fluvial erosion hazard zoning**
  Sponsors: Prime –Rep. Gene Andersen

# NH FEH Applicability to Great Bay:

- Chesepeake Bay Approach
  - Watershed-management plans that address the ***protection, conservation, and restoration of stream corridors, riparian forest buffers, & wetlands*** would be developed to meet the proposed goals.

    (USGS, Water-Resources Investigations Report 03-4123)

# Regional Supporting Data for Floodplain Restoration

- Black Creek Floodplain Restoration (Bakersfield & Fairfield, VT)
- 200 acres of reconnected Floodplain
- Year 1 Data
  - 950 cubic yards of sediment
  - 1.1 tons of phosphorus

    (VTDEC, Unpublished 2008)

# Questions?